What is the relationship between the intake of milk and milk products and metabolic syndrome?

Conclusion

Limited evidence is available showing intake of milk and milk products are associated with reduced risk of metabolic syndrome.

Grade: Limited

Overall strength of the available supporting evidence: Strong; Moderate; Limited; Expert Opinion Only; Grade not assignable For additional information regarding how to interpret grades, click here.

Evidence Summary Overview

Intake of milk and milk products is associated with reduced risk of metabolic syndrome and may even be protective in certain population groups. The conclusion reached for this question is based on one systematic review with meta-analysis (Elwood, 2008), one prospective cohort study (Snijder, 2008) and two cross-sectional studies (Beydoun, 2008; Ruidavets, 2007).

Elwood et al, (2008) performed a systematic review and meta-analysis and the data showed a reduction in risk associated with the highest level of milk consumption for metabolic syndrome (RR=0.74; 95% CI: 0.64, 0.84) compared to the risk in those with low consumption.

Snijder et al, (2008) conducted a prospective cohort study investigating the association between dairy consumption and changes in weight and metabolic disturbances. The authors concluded that dairy consumption was not associated with changes in metabolic variables in a Dutch elderly population. Two cross-sectional studies (Beydoun, 2008; Ruidavets, 2007) looked at milk and milk product consumption and metabolic syndrome. The French study by Ruidavets et al, (2007) determined that the intake of dairy products was associated with a lower probability of insulin resistance syndrome. No significant (NS) associations between whole milk (per 100g), low-fat milk (per 100g) or skim milk (per 100g) and metabolic syndrome were observed in a study of National Health and Nutrition Examination Surveys (NHANES) 1999-2004 data (Beydoun, 2008).

Evidence Summary Paragraphs

Systematic Review/Meta-Analysis

Elwood et al, 2008 (positive quality) performed a systematic review and meta-analysis to investigate the literature on milk and dairy consumption and risk of vascular disease and diabetes, examine the evidence related to consumption of whole vs. reduced fat milk and disease risk and consider the likely effect of milk and dairy consumption on survival. The authors also reviewed a 2007 report by the World Cancer Research Fund to determine the impact of milk and dairy consumption on cancer risk. Using Cochrane systematic review methods, MEDLINE was searched up to June 2008 using key words milk/milk protein/dairy/dairy calcium and heart disease/ coronary artery disease (CAD)/myocardial infarction (MI)/ischaemic heart disease (IHD), stroke and diabetes/metabolic

syndrome. This search revealed 180 papers on milk and heart disease, 33 papers on milk and stroke, and 111 papers on milk and diabetes. Only studies that were done in human adults using population-based and prospective designs and reported baseline data on milk or dairy consumption, vascular disease outcome or incident diabetes were included in the final review. The final sample included 15 prospective studies on IHD and stroke, four prospective studies on diabetes, four case-control studies on metabolic syndrome and four case-control studies on MI. The data showed a reduction in risk associated with the highest level of milk consumption for metabolic syndrome (RR=0.74; 95% CI: 0.64, 0.84).

Prospective Cohort Study

Snijder et al, 2008 (positive quality), a prospective cohort study conducted in the Netherlands, investigated the association between dairy consumption and changes in weight and metabolic disturbances, based on data from the Hoorn study, a population-based cohort of white men and women aged 50-75 years. Average food intake was measured at baseline using a 92-item semi-quantitative food-frequency questionnaire (FFQ). At baseline and follow-up, participants underwent an extensive physical examination and a blood sample was drawn for biochemical analyses of fasting glucose, post-load glucose, high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C) and triglycerides (TG). During the physical examination, weight, waist circumference (WC) and blood pressure (BP) were measured. 1,124 participants were included in the analysis. Baseline dairy consumption was not associated with changes in fasting and post-load glucose concentrations, serum lipid levels or BP, nor with the risk of developing metabolic syndrome in 6.4 years (OR=0.86, 95% CI: 0.52, 1.42, comparing highest with lowest quartile of dairy consumption). The authors concluded that dairy consumption was not associated with changes in metabolic variables in a Dutch elderly population.

Cross-Sectional Studies

Beydoun et al, 2008 (positive quality), a cross-sectional analysis of merged NHANES data from 1999-2004 in the US, assessed the association between consumption of dairy and related nutrients and obesity, central obesity and the metabolic syndrome. Out of 17,061 subjects over age 18 years (8,970 women and 8,091 men) with complete demographic data, 4,519 subjects had complete data on dietary intake (assessed from 24-hour recall data) and metabolic outcomes, such as weight, height, WC, BP and laboratory values (fasting blood glucose, triacylglycerol stores and HDL-C). On average, adults consumed 1.54 servings of dairy (0.90 in fluid milk and 0.60 in cheese) per day. Each serving of dairy products increased the risk of MetS by 8% among men. Odds ratios (OR) for one more daily serving of yogurt for metabolic syndrome was 0.40 (95% CI: 0.18, 0.89; $P<0.05$) and ORs for one more daily serving of cheese for metabolic syndrome was 1.16 (95% CI: 1.04, 1.29; $P<0.05$). No significant associations between whole milk (per 100g), low-fat milk (per 100g) or skim milk (per 100g) and metabolic syndrome were observed.

Ruidavets et al, 2007 (neutral quality), a cross-sectional study conducted in France, analyzed the relation between various food groups and the frequency of insulin resistance syndrome. Participants were recruited from the population as part of the French MONICA Study (Monitoring of Trends and Determinations in Cardiovascular Disease). Anthropometric data were taken, including WC, waist-to-hip ratio (WHR) and body mass index (BMI); BP was measured twice and fasting blood samples were analyzed for lipid and glucose measurements. Intakes of dairy products, fish or cereal grains were measured through food records with follow-up interviews by a dietitian. After those without complete data were excluded, 912 men aged 45-64 years remained in the analysis. The prevalence of insulin resistance syndrome was 23.5%, and it reached 29.0%, 28.1% and 28.1% when the intake was below the median for fish, dairy products and cereal grains, respectively. After

adjustment for confounding variables, the ORs for insulin resistance syndrome (above median values vs. below) were 0.51 (95% CI: 0.36, 0.71) for fish, 0.67 (95% CI: 0.47, 0.94) for dairy products and 0.69 (95% CI: 0.47, 1.01) for cereal grains. When intakes of all three food groups were high, the odds ratio was 0.22 (95% CI: 0.10, 0.44), leading the authors to conclude that a high consumption of dairy products, fish or cereal grains is associated with a lower probability of insulin resistance syndrome, especially when intakes of all three food groups is high.

View table in new window

Author, Year, Study Design, Class, Rating	Participants	Description of Study Design	Outcomes
Beydoun et al 2008 Study Design: Cross-sectional Study Class: D Rating: 	N=4,519 subjects with complete data on dietary intake and metabolic outcomes (Out of 17,061 subjects over age 18 years (8,970 women and 8,091 men) with complete demographic data). Location: United States.	Cross-sectional analysis of merged NHANES data from 1999-2004 in the US, assessed the association between consumption of dairy and related nutrients and obesity, central obesity and metabolic syndrome. Included subjects had complete data on dietary intake (assessed from 24-hour recall data) and metabolic outcomes, such as weight, height, WC, BP and laboratory values (FBG, TG stores and HDL-C).	On average, adults consumed 1.54 servings of dairy (0.90 in fluid milk and 0.60 in cheese) per day. Each serving of dairy products ↑ the risk of MetS by 8% among men. OR for one more daily serving of yogurt for metabolic syndrome was 0.40 (95% CI: 0.18, 0.89; P<0.05) and OR for one more daily serving of cheese for metabolic syndrome was 1.16 (95% CI: 1.04, 1.29; P<0.05). NS associations between whole milk (per 100g), low-fat milk (per 100g) or skim milk (per 100g) and metabolic syndrome were observed.

Elwood PC, Givens DI et al, 2008 Study Design: Systematic review and meta-analysis Class: M Rating: 	Final N=15 prospective studies on IHD and stroke: • Four prospective studies on diabetes • Four case-control studies on metabolic syndrome • Four case-control studies on MI.	MEDLINE was searched up to June 2008 using key words: Milk/milk protein/dairy/dairy calcium and heart disease/coronary artery disease/ myocardial infarction/ ischaemic heart disease, stroke and diabetes/ metabolic syndrome.	Data showed a ↓ in risk associated with the highest level of milk consumption for metabolic syndrome (RR=0.74; 95% CI: 0.64, 0.84).
Ruidavets et al 2007 Study Design: Cross-sectional Study Class: D Rating: 	N=912 men after those without complete data were excluded. Age: 45-64 years. Location: France.	Cross-sectional study analyzing the relation between various food groups and the frequency of insulin resistance syndrome. Participants were recruited from the population as part of the French MONICA Study (Monitoring of Trends and Determinations in Cardiovascular Disease). Anthropometric data were taken, including WC, WHR and BMI; BP was measured twice and fasting blood samples were analyzed for lipid and glucose measurements. Intakes of dairy products, fish or cereal grains were measured through food records with follow-up interviews by a dietitian.	Prevalence of insulin resistance syndrome was 23.5% and it reached 29.0%, 28.1% and 28.1% when intake was below the median for fish, dairy products and cereal grains, respectively. After adjustment for confounding variables, the OR for insulin resistance syndrome (above median values vs. below) were 0.51 (95% CI: 0.36, 0.71) for fish, 0.67 (95% CI: 0.47, 0.94) for dairy products and 0.69 (95% CI: 0.47, 1.01) for cereal grains. When intakes of all three food groups were ↑, the OR was 0.22 (95% CI: 0.10, 0.44), leading authors to conclude that a ↑ consumption of dairy

			products, fish or cereal grains is associated with a ↓ probability of insulin resistance syndrome, especially when intakes of all three food groups is ↑.
Snijder et al 2008 Study Design: Prospective Cohort Study Class: B Rating:	N=1,124 participants in the Hoorn study, a population-based cohort of white men and women. Age: 50-75 years. Location: Netherlands.	Prospective cohort study investigating the association between dairy consumption and Δ in weight and metabolic disturbances. Average food intake measured at baseline using a 92-item semi-quantitative FFQ. At baseline and follow-up, participants underwent extensive physical exam and blood sample drawn for biochemical analyses of FBG, post-load glucose, HDL-C and LDL-C and TG. During physical exam, weight, WC and BP were measured.	Baseline dairy consumption was not associated with Δ in fasting and post-load glucose concentrations, serum lipid levels or BP, nor with risk of developing metabolic syndrome in 6.4 years (OR=0.86, 95% CI: 0.52, 1.42, comparing highest with lowest quartile of dairy consumption). Authors concluded that dairy consumption was not associated with Δ in metabolic variables in a Dutch elderly population.

Research Design and Implementation Rating Summary
For a summary of the Research Design and Implementation Rating results, click here.

Worksheets

Beydoun MA, Gary TL, Caballero BH, Lawrence RS, Cheskin LJ, Wang Y. Ethnic differences in dairy and related nutrient consumption among US adults and their association with obesity, central obesity, and the metabolic syndrome. *Am J Clin Nutr.* 2008 Jun;87(6):1914-25.

Elwood PC, Givens DI, Beswick AD, Fehily AM, Pickering JE, Gallacher J. The survival advantage of milk and dairy consumption: An overview of evidence from cohort studies of vascular diseases, diabetes and cancer. *J Am Coll Nutr.* 2008; 27 (6): 723S-734S

Ruidavets JB, Bongard V, Dallongeville J, Arveiler D, Ducimetière P, Perret B, Simon C, Amouyel P, Ferrières J. High consumptions of grain, fish, dairy products and combinations of these are associated with a low prevalence of metabolic syndrome. *J Epidemiol Community Health.* 2007 Sep;61(9):810-7.

Snijder MB, van Dam RM, Stehouwer CD, Hiddink GJ, Heine RJ, Dekker JM. A prospective study of dairy consumption in relation to changes in metabolic risk factors: the Hoorn Study. *Obesity (Silver Spring).* 2008 Mar;16(3):706-9. Epub 2008 Jan 17.